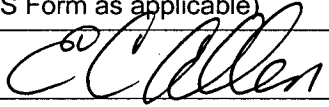


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Subcontractor: Nevada Rail Partners	Item Number/Title/Revision: T6/Route Alignment Definition - <i>Alignment Development Report, Mina Rail Corridor</i> - NRP-R-SYSW-DA-0003-00, Rev. 00 Exhibit I, Item Number 10v, RFP Reference Exhibit D-2.6c.2	Submittal Date: April 20, 2007	SRCT No.: 07- 00052
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Section I. Submittal Information (includes above information)

Submittal Description and Revision Summary for Entire Submittal:

This is the final submittal (Rev. 00) of Alignment Development Report, Mina Rail Corridor. Duplicate information from Alignment Development Report, Caliente Rail Corridor (Rev. 02) is not repeated herein; this report references the original location of the data in the Caliente report. This revision incorporates responses to comments provided by BSC.

The purpose of the alignment report is to document the activities completed to develop feasible, engineered alignments for multiple segments of rail line within the Mina Rail Corridor. The report describes the basis of alignment development (including assumptions and data sources), the process, and presents findings in terms of engineering data for each of the alignment segments.

Special Instructions:

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Section II. Data File Information (Add lines below if needed for additional files. Indicate "Last item" or "End of list" on last line used.)

Filename	Rev.	File Size	Description (File description and revision summary for file)	Application and Version/ Add-in or Extension and Version
T6_Cover.ppt	00	701 KB	Report cover for the <i>Alignment Development Report, Mina Rail Corridor</i> Rev. 00	Microsoft Powerpoint 2003
T6_MRC_Alignme ntDevelopment_Re v00_20April07.doc	00	2,346 KB	Main text with all imbedded graphics and appendices – <i>Alignment Development Report, Mina Rail Corridor</i> – NRP-R-SYSW-DA-0003-00, Rev. 00	Microsoft Word 2003
T6_MRC_Alignme ntDevelopment_Re v00_20April07.pdf	00	1,560 KB	Scanned version of the complete document with all imbedded graphics and appendices – <i>Alignment Development Report, Mina Rail Corridor</i> – NRP-R-SYSW-DA-0003-00, Rev.00	Adobe Acrobat 7.0 Standard Version
T6_MRC_Alignme ntDevelopment_Re v00_20April07_Re adonly.doc	00	2,346 KB	Main text (Read Only) with all graphics and appendices – <i>Alignment Development Report, Mina Rail Corridor</i> – NRP-R-SYSW-DA-0003-00, Rev. 00	Microsoft Word 2003
T6_MRC_Alignme ntDevelopment_Re v00_FINALredline _20April07.pdf	00	4-23-07 6 962 KB 952	Scanned redline version of the complete document with all imbedded graphics and appendices – <i>Alignment Development Report, Mina Rail Corridor</i> – NRP-R-SYSW-DA-0003-00, Rev.00	Adobe Acrobat 7.0 Standard Version
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Section III. Metadata

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	Zone:
	Units:
<input type="checkbox"/> CAD Metadata CAD drawings are preferred in Bentley MicroStation V8 and/or InRoads and should adhere to established CAD standards.	Level descriptions:
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	Horizontal and Vertical Datum:

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Subcontractor: Nevada Rail Partners	Item Number/Title/Revision: T6/Route Alignment Definition - <i>Alignment Development Report,</i> <i>Mina Rail Corridor</i> - NRP-R-SYSW-DA-0003-00, Rev. 00 Exhibit I, Item Number 10v, RFP Reference Exhibit D-2.6c.2	Submittal Date: April 20, 2007	SRCT No.:
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Note: Prior submission received with an incorrect revision and document number. This has been corrected.

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Alignment Development Report Mina Rail Corridor

Task 6: Route Alignment Definition

Rev. 00

Document No. NRP-R-SYSW-DA-0003-00

RAIL ROAD
CROSSING

Prepared by:



Prepared for:



Nevada Rail Line Conceptual Design

Subcontract NN-HC4-00239

April 20, 2007

Alignment Development Report Mina Rail Corridor

Task 6: Route Alignment Definition

Rev. 00

Document No. NRP-R-SYSW-DA-0003-00

Nevada Rail Line Conceptual Design

Subcontract NN-HC4-00239

20 April 2007

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Acronyms

ADT	average daily traffic
ALW	Administrative Land Withdrawal
BC	Bonnie Claire
BLM	Bureau of Land Management
BSC	Bechtel SAIC Company, LLC
CRC	Caliente Rail Corridor
CS	Common Segment
DEM	digital elevation model
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
EIS	Environmental Impact Statement
FEMA	Federal Emergency Management Agency
GF	Goldfield
GIS	geographic information systems
lb	pound(s)
MN	Mina Segment
mph	miles per hour
MCS	Mina Common Segment
MRC	Mina Rail Corridor
NAD	North American Datum
NDOT	Nevada Department of Transportation
NRL	Nevada Rail Line
NRP	Nevada Rail Partners
NTRD	Nevada Transportation Requirements Document
PVI	point of vertical intersection
OV	Oasis Valley
RA EIS	Rail Alignment Environmental Impact Statement
Repository	Yucca Mountain Geologic Repository
Rev.	Revision
ROW	right-of-way
S	Schurz Segment
UPRR	Union Pacific Railroad
US 95	U.S. Highway 95
USGS	U.S. Geological Survey
UTM	Universal Transverse Mercator

1.1 PURPOSE

The project addressed in this report is the Nevada Rail Line (NRL), which would connect the existing national rail system with the U.S. Department of Energy's (DOE's) potential Yucca Mountain Geologic Repository (Repository). The site would be the nation's first geological repository designed to store and dispose of spent nuclear fuel and high-level radioactive waste. The NRL would provide a means of transporting the waste by rail to the Repository as well as transporting construction materials by rail to support Repository operations. Two potential corridors between the existing national rail system and the Repository have been evaluated: 1) the Caliente Rail Corridor (CRC), beginning near Caliente, Nevada, and 2) the Mina Rail Corridor (MRC), beginning near Fort Churchill, Wabuska, Nevada (see Figure 1-A).

This report describes the development process for the MRC alignment.¹ The MRC alignment was determined based on an engineering process that considered design constraints and opportunities within the study area. The resulting MRC alignment is 281 miles long from Fort Churchill to the Repository at the southern terminus, and consists of approximately 27 miles of existing U.S. Department of Defense (DOD) rail line and 254 miles of new rail construction. The MRC shares two common northern segments with the DOD rail line near Fort Churchill, and shares three common southern segments with the CRC alignment from Lida Junction to the Repository. The MRC basis for analysis² and alternate segments are presented in Table 1-1.

Table 1-1. MRC Basis for Analysis and Alternate Segments

Basis for Analysis	Alternate Segments
MCS0	None
S1	S4, S5, S6
MCS1/DOD	None
MCS1	None
MN1	MN2 (MN2/MN3, MN2, MN2/GF4, MN2/CS4)
MN1/MN3	MN3 (MN2/MN3, MN3, MN1/MN3)
MCS2/CS4	None
BC3	BC2
CS5	None
OV1	OV3
CS6	None

¹ Throughout this report, the term "alignment" refers to the engineered centerline within the corridor where the rail line would be constructed. "NRL" is used to describe aspects of the rail that are not particular to a specific alignment, and "MRC" is used only where specifically applicable to the alignments of the Mina Rail Corridor.

² Throughout this and other Nevada Rail Partners (NRP) reports, the phrase "basis for analysis" is used to provide a frame of reference for NRP's evaluations of the alignment's construction engineering and operational characteristics. Except for *Operations and Maintenance Report, Mina Rail Corridor* (NRP 2007g), NRP reports provide data for all alignment segments so that consideration of other alternate alignment segment combinations can be accomplished.

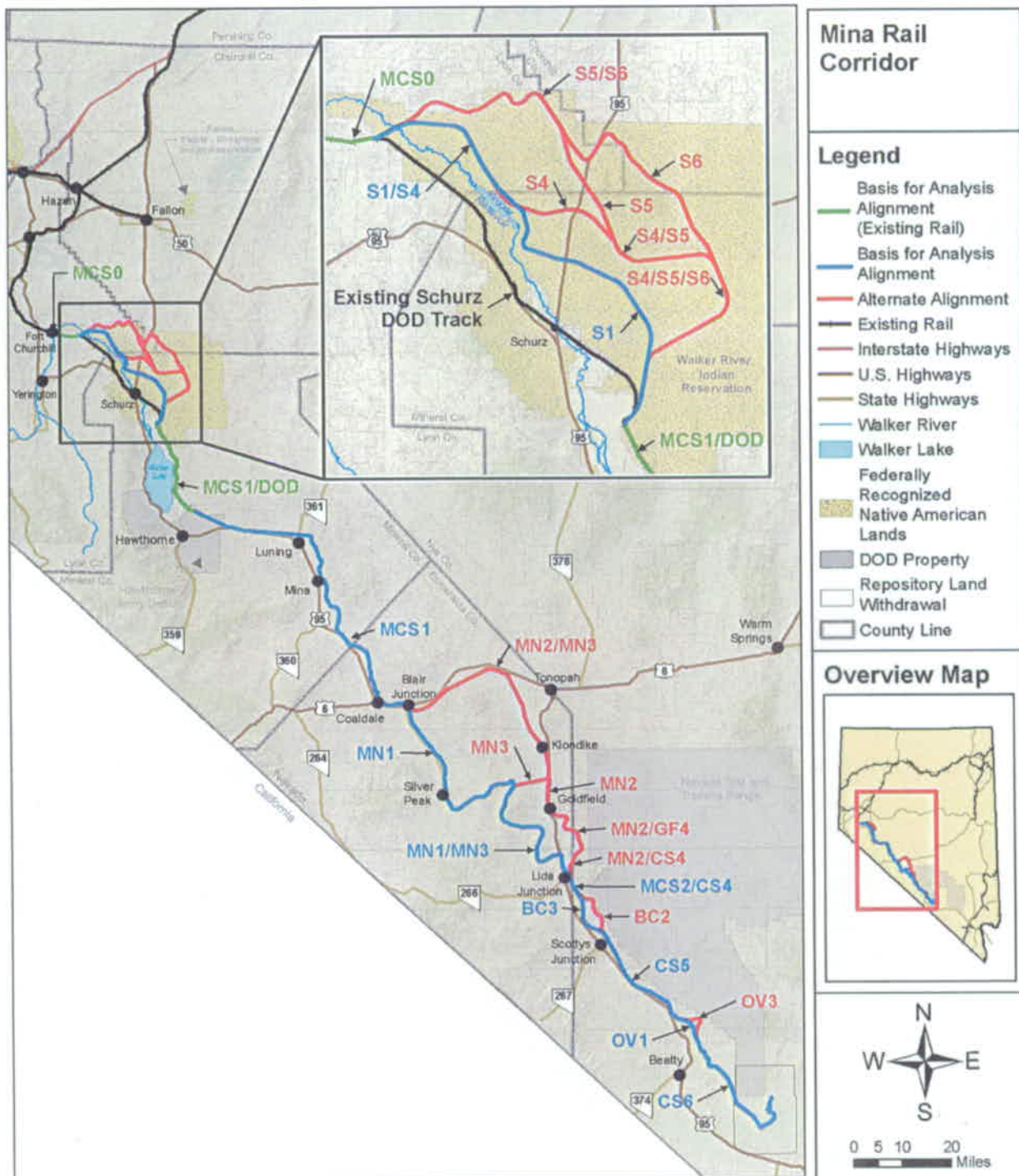


Figure 1-A. MRC Overview Map

The objective of this report is to describe the conceptual engineering process used to develop a feasible rail alignment for the MRC. The resulting MRC alignment accomplishes the following:

- Forms a basis for preliminary engineering.
- Represents a concept that is constructable.
- Supports safe and practicable rail operations.
- Supports the *Rail Alignment Environmental Impact Statement* (RA EIS) process.

1.2 CONTENTS

This *Alignment Development Report* documents the conceptual design methodology used to develop feasible segments unique to the MRC alignment.³ The methodology consists of guiding parameters and the design process applied to develop each segment of the MRC alignment. The results of this design process provide measurable criteria for differentiating among alternate segments. This report describes three principal elements of the conceptual design methodology:

Basis of the Alignment Development – The report identifies the requirements, standards, previous activities, and design criteria forming a framework that bounded the conceptual design. This bounding framework is composed of geographic limits to the alignments as well as input from institutional processes, technical standards, and established industry practices.

Alignment Development Process – The systematic process consisted of steps that created feasible, engineered rail alignments from the general routing defined by the studies conducted for the previous *Repository Environmental Impact Statement* (EIS) (DOE 2002a) and the subsequent refinement during the RA EIS scoping process (DOE 2006). This report describes and documents the steps involved in the design process.

Alignment Development Findings – The development of feasible, engineered alignments has identified parameters for the development of the MRC alignment and for each of the individual segments. This report tabulates and describes these specific findings.

This report is not intended to be a stand-alone document. Sections that overlap with or duplicate information contained in *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b) reference the location of the data in the CRC document.

The following five appendices to this report contain information supporting the three principal elements of the conceptual design methodology. Refer to *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b) for Appendices A and B.

- Appendix A – NRL Conceptual Design Technical Briefs
- Appendix B – Proposed NRL Design Criteria Basic Elements
- Appendix C – Engineering Findings
- Appendix D – Engineering Parameters that Characterize Alignment Segments
- Appendix E – Alignment Narrative Reports

This report is one of several prepared to support and provide initial input to the first draft of the RA EIS. The other reports are as follows:

- *Air Quality Emission Factors and Socioeconomic Input, Mina Rail Corridor* (NRP 2007a)

³ Details regarding the alignment development process for common segments shared by the MRC and CRC are provided in *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b).

- *Comparative Cost Estimates, Mina Rail Corridor* (NRP 2007c)
- *Construction Plan, Mina Rail Corridor* (NRP 2007d)
- *Engineered Plan and Profile Drawing Set, Mina Rail Corridor* (NRP 2007e)
- *Facilities-Design Analysis Report, Mina Rail Corridor* (NRP 2007f)
- *Operations and Maintenance Report, Mina Rail Corridor* (NRP 2007g)
- *Route Sections and Structures Report, Caliente Rail Corridor* (NRP 2007h)⁴

Each report covers a specific topic for a specific purpose. Accordingly, each report utilizes data from various sources in varying levels of detail and precision as appropriate, as well as in different contexts. Although the reports are consistent in overall conceptual design, numerical values for certain parameters may vary from one report to another. This variation is due to the conceptual nature of the reports and their distinct areas of focus; it should not be considered an abnormal situation or an indication of error.

⁴ The typical sections are the same for both the MRC and CRC; therefore *Route Sections and Structures Report, Caliente Rail Corridor* (NRP 2007h) applies to both corridors.

2.1 BASIS OF ALIGNMENT DEVELOPMENT

The purpose of alignment development is to identify feasible alignments that may be considered for further study or final design based on the evaluation and assessment of design constraints and opportunities. Several preliminary studies and design evaluations were used to initiate the alignment development process for the MRC. These studies and evaluations include:

- *Preliminary Rail Access Study* (DOE 1990)
- *Nevada Potential Repository Preliminary Transportation Strategy, Study 1* (DOE 1995)
- *Nevada Potential Repository Preliminary Transportation Strategy, Study 2* (DOE 1996)
- *Nevada Transportation Requirements Document* (NTRD) (Bechtel SAIC Company, LLC [BSC] 2005)
- *Mina Rail Route Feasibility Study* (BSC 2006)
- NRL design criteria (currently in draft status)
- Engineering data needs requested by the RA EIS team

The Mina route was first introduced as the Mina Spur Option in DOE's 1990 study and was carried forward for evaluation in DOE's 1995 study. A year later, DOE conducted another study, which eliminated the Mina option from further consideration due to the Walker River Paiute Tribe's objection to the rail line crossing the Walker River Indian Reservation in order to connect to an existing rail line in Nevada (DOE 1996). Following review of the scoping comments for the RA EIS, DOE continued coordination with the Walker River Paiute Tribe. In May 2006, the tribe granted permission for DOE to study the Mina option so that the tribe could make a more informed decision about the project alignment. Therefore, the *Mina Rail Route Feasibility Study* (BSC 2006) was prepared to identify a feasible alignment that could be carried forward for study in the RA EIS.

NTRD (BSC 2005) – The primary purpose of the NRL is to provide a means of transporting spent nuclear fuel and high-level radioactive waste to the Repository. A secondary purpose of the NRL is to provide construction materials to the Repository and to support Repository operations. DOE has identified specific functional requirements and criteria for design and operation of the NRL, which establish the weight limits for structural loading of the track and bridges, overall train consists required for determining horsepower, and braking requirements. These requirements, taken in part from DOE's *Integrated Interface Control Document*, Volume 1 (DOE 2002b), are important to the formulation of specific criteria for design and operation of the NRL.

During early conceptual design activities, several topics important to the development of the NRL were considered. These topics included train consists, fencing, access roads, and grades. Of these topics, grades are of critical importance to alignment development and form one of the bounding conditions in the conceptual design process. The technical brief pertaining to this topic is reproduced in Appendix A of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b).

Mina Rail Route Feasibility Study (BSC 2006) – The feasibility study considered the original Mina option from the DOE 1990 study. Since the 1990 study, the design criteria for the potential railroad have been updated. The MRC route segments have been designed and evaluated based on previous studies, preliminary field reviews, and updated design criteria. The MRC alignment was developed to meet the following objectives:

- Maximize the use of federal lands.
- Provide access to any of the regional rail carriers.
- Avoid obvious or potential land use conflicts.

- Meet the requirements of current railroad engineering practices.
- Avoid lands withdrawn from federal action.

In October 2006, DOE initiated additional public scoping for consideration of the Mina route in the Draft RA EIS. Scoping meetings were held in Las Vegas, Amargosa Valley, Goldfield, Reno, Fallon, Hawthorne, and Caliente (DOE 2006). The following table compares engineering criteria for the NRL.

Table 2-1. Comparison of Engineering Criteria Used in Early Stages of Project Formulation to Current Criteria Proposed by NRL

Parameter	Criteria Used for Preliminary Segments	Criteria Used for RA EIS
Horizontal curvature (maximum)	8.73 degrees	6.00 degrees
Grades (maximum)	2.0 percent uncompensated for curvature	2.0 percent compensated for curvature
Speed, in miles per hour (mph)	60	60
Track section	115-pound (lb) rail timber ties 6 – 12 inches of ballast light-density rail traffic	136-lb rail concrete ties 12 inches of ballast 18-inch ballast shoulder

NRL Design Criteria – Design criteria have been prepared to define the technical design basis for the conceptual design. These criteria are based on requirements found in the NTRD, which defines the safety and functional requirements associated with waste transport (BSC 2005).

These criteria have been developed in coordination with established practices of the national rail system and railroad companies and with industry guidelines such as those published by the American Railway Engineering and Maintenance of Way Association and other professional associations of the railroad industry. For example, a primary requirement of the NRL is a desired design speed of 60 mph. This requirement establishes limits of horizontal geometry and vertical grade for safe operation. Appendix B of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b) contains a summary of these criteria. Criteria from the Nevada Department of Transportation (NDOT) will also be incorporated with NRL design requirements.

Engineering Data Needs Requested by the RA EIS Team – Environmental considerations were a priority while developing the MRC alignment. The collection of environmental field data (such as biological resources and cultural/historic features) is ongoing and concurrent with development of the conceptual design alignment. It is anticipated that there will be additional field data inputs and that the alignment development, as currently documented, may require modification.

2.2 MAPPING DATA

The MRC Revision (Rev.) 00 (July 2006) conceptual design was based on public domain mapping data from U.S. Geological Survey (USGS) 1:24,000-scale digital elevation models (DEMs). Existing infrastructure and physical features such as roads, washes, and private land were captured from BSC's geographic information systems (GIS) database. NRP generated contour mapping based on the USGS DEMs that can be utilized in Microstation computer-aided design software (discussed in greater detail in Section 3.2).

2.0 Methodology

NRP-generated contours, infrastructure, and physical features were all gathered in Universal Transverse Mercator (UTM) Zone 11, North American Datum (NAD) 83, English.

Average daily traffic (ADT) data for state and federal highways were obtained from NDOT.

For the MRC Rev. 0A (February 2007) conceptual design, BSC provided mapping data based on 1:20,000-scale aerial photography taken during the spring and summer of 2006. Digital, ortho-rectified photos, digital terrain models, and topographic maps were generated (in UTM Zone 11, NAD 83, English) as products for use. The change from NAD 27 to NAD 83 was made to comply with project requirements. A large number of planimetric features were captured on the topographic maps (including roads and water features). Other features, such as private lands and jurisdiction, were captured from BSC's GIS database. The digital terrain models were used to generate triangulated irregular network models for use in InRoads software (discussed in greater detail in Section 3.2).

The alignment used as the basis for analysis in this report is discussed in Section 3.0.

3.1 PROCESS STEPS

The alignment development process followed a systematic series of steps which first created and then progressively refined feasible, engineered alignments. The starting point of this conceptual design development process was the Mina option from the DOE 1990 study. The series of steps that developed the feasible, engineered alignments includes:

- Develop initial engineered geometry.
- Refine and adjust geometry.
- Prepare initial alignment drawings to support field investigations.
- Define basis for analysis.

These progressive steps developed the segments that emerged from previous studies into alignments with engineered geometry for analysis and comparative evaluation. The alignment development steps for the MRC are modeled after the steps used to develop the CRC and are summarized in Section 3.0 of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b). Details pertaining to the MRC alignment are presented in other studies, including *Engineered Plan and Profile Drawing Set, Mina Rail Corridor* (NRP 2007e) and *Mina Route Alignment Development Evolution Report* (NRP 2006).

3.2 EXPLANATION OF PROCESS

The general steps are summarized in the following paragraphs:

Develop Initial Engineered Geometry – NRP developed alignments using Microstation (Version 8) along with the alignment-specialty software InRoads (Version 8). Microstation is a civil engineering software package used for creating engineering drawings. InRoads is a software package that computes an alignment's horizontal and vertical geometry, and also computes the cut and fill (earthwork) needed to construct the defined alignment. InRoads computes an alignment's geometry, incorporating topographic information (see Section 2.2 of this report), a designated location, cross section templates, and engineering criteria. The alignments are defined by specific geometric parameters such as horizontal curve geometry, tangent segment lengths, and vertical grade percentages.

Refine and Adjust Geometry – Plots of each initially engineered InRoads alignment were examined for opportunities to refine the alignments. The refinements had the following effects:

- Established alignment geometry that adhered to the NRL requirements and design criteria. The refinement reduced the potential areas of speed restrictions and thus improved transit time across the alignment segments.
- Improved operational safety, reliability, and functionality. The rail alignment was refined:
 - To remove geometric conditions such as reverse curves without intermediate tangent segments.
 - To reduce track with horizontal curves superimposed on vertical curves.
 - To compensate vertical grade where horizontal curves occurred.
 - To reduce vertical undulation and the associated roller coaster effect.
- Improved constructability. In a few alignments, embankment fill areas were very high; that is, they were over 100 feet above the natural grade. Rather than engineer a bridge at these locations, the conceptual design was adjusted to include embankment fill. This provided the RA EIS process with a design that would represent a bounding case for surface area disturbance, earth moved, and other environmental factors.

3.0 Alignment Development Process

- Lowered operational cost. Because frequent curvature, tunnels, and frequent changes in vertical gradient are all features that increase operating costs, the refinements focused on areas where curves and gradients could be flattened and where tunnels could be avoided.
- Reduced complex geometry. Tangent sections were inserted in some portions of the alignment to reduce the frequency of reverse curves.
- Made more efficient use of existing terrain. Large sections of the Mina alignment are located on an existing, abandoned railroad alignment. Some of these sections were adjusted within the MRC to take advantage of slopes and hillsides that would smooth the profile by refining vertical curves. In other segments, the alignment was adjusted to improve the earthwork balance, which improves constructability. Balanced earthwork also reduces permitting issues by eliminating the need to permit borrow sources or waste spoil areas.

Other refinements included adjusting the alignment to shorten bridges or shifting the alignment to avoid costly engineering works such as tunnels. The consideration of these engineering issues resulted in repeated, iterative refinements of the initial InRoads alignment until it was judged that a feasible alignment (given the current, available data) was developed.

Prepare Initial Alignment Drawings to Support Field Investigations – Once a refined and adjusted alignment was identified, plan and profile information was plotted and distributed to the RA EIS team as interim documents. The plots were at a horizontal scale of 1 inch = 2,000 feet. Electronic versions were also provided so that the RA EIS team could reproduce the information at a different scale, depending on the desired use. These drawings were used by the RA EIS team to guide field investigations and to locate environmental resources such as wetlands, unique habitat, and cultural features.

The current status of the MRC conceptual design presents an alignment that successfully executes DOE's Record of Decision for the Repository and Notice of Intent for the RA EIS. The development of the alignment followed these steps:

- Acknowledge any environmental avoidance areas designated by the RA EIS Contractor.
- Seek a feasible, engineered alignment within the MRC.
- Evaluate whether impacts (such as total earth moved) can be reduced with an alignment beyond the corridor.
- Evaluate any remaining high-impact areas within the segments.

Following receipt of new aerial mapping and terrain models, the draft alignment typically altered the centerline location of earlier alignments by several hundred feet, and occasionally by a greater distance, if impacts could be reduced and the feasibility of the alignment could be improved.

Environmental and geotechnical considerations were a priority while developing the alignment. Water availability is a major issue that simultaneously affects the NRL's engineering design, environmental effects, permitting constraints, and project costs. The principal factor affecting water demand is earthwork; about 90 percent of the water needed for the project would be used to provide for compaction of embankment fill materials and to control dust during excavation and other earth-moving activities. Track profile was prepared with the objective of balancing earthwork quantities (that is, keeping the total excavation [cut] approximately equal to the placement of embankment [fill]). However, the conceptual design approach was to adjust the profile to reduce cut and fill. Reducing fill also decreases the water demand for embankment compaction. Geotechnical issues identified in the development of the Caliente alignment were also a factor in developing the Mina alignment.

The draft alignment was prepared with limited hydrologic and hydraulic data input. Preliminary design discharges for drainage structures along the alignment were determined using data from regionalized

3.0 Alignment Development Process

regression equations. Structures that would be located in Federal Emergency Management Agency (FEMA) Flood Zone A, the 100-year floodplain, would be designed to convey 100-year flows with minimal impoundment of water upstream of the structure in a manner consistent with FEMA guidelines and county regulations. Structures that would be located in areas not studied by FEMA would be designed to comply with appropriate county regulations. The design would temporarily impound flows but would minimize potential impacts to flooding and sediment transport at other locations.

Information was also provided regarding potential biological avoidance areas along the MRC. Threatened or endangered species, and other special status biological resources, are known to occur at a few locations along the MRC. In these areas, the design, construction, and operation of the rail line will have to include plans to mitigate impacts to these resources. The presence of these species should not prevent construction of the MRC. Construction may have some impacts to this habitat. Additional surveys may be required to determine if specific species can currently be found in the MRC study area.

Define Basis for Analysis – The final step in the alignment development process is to compare the alternate segments for the purpose of identifying a continuous alignment that could be used as the basis for analysis alignment for other components of the conceptual design. These components include studies that are currently in progress:

- *Air Quality Emission Factors and Socioeconomic Input, Mina Rail Corridor* (NRP 2007a)
- *Comparative Cost Estimates, Mina Rail Corridor* (NRP 2007c)
- *Construction Plan, Mina Rail Corridor* (NRP 2007d)
- *Operations and Maintenance Report, Mina Rail Corridor* (NRP 2007g)

Table 3-1 summarizes the alignment characteristics for comparison of alternate segments. Two segments (MCS1 and MN2/GF4) were excluded from Table 3-1 because no alternate segments are available for comparison. Figure 3-1 shows the continuous alignment that is used as the basis for analysis and alternate alignment segments.

Table 3-1. Comparison of MRC Alignment Segments

Segment Name	Segment			
Schurz	S1	S4	S5	S6
	<ul style="list-style-type: none">• Shortest and likely the least expensive to construct	<ul style="list-style-type: none">• More rugged terrain and slightly longer than S1	<ul style="list-style-type: none">• More rugged terrain and slightly longer than S1 and S4	<ul style="list-style-type: none">• One of the longest, most rugged, and likely most expensive to construct• Heavy earthwork• Difficult engineering for U.S. Highway 95 (US 95) crossing

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Table 3-1. Comparison of MRC Alignment Segments

Segment Name	Segment		
Mina	MN1	MN2	MN3
	<ul style="list-style-type: none"> • Traverses between the Silver Peak town site and existing industry • Rugged topography at south end of alignment • Most earthwork, highest percentages of curvature and heavy grades 	<ul style="list-style-type: none"> • Gentle topography • Least amount of earthwork • Biggest impact on mining claims and town of Goldfield • Follows an existing rail bed for a significant portion of route 	<ul style="list-style-type: none"> • Combination of MN1 and MN2 • Rugged topography at south end of alignment • Follows an existing rail bed for a significant portion of route
Bonnie Claire	BC2	BC3	
	<ul style="list-style-type: none"> • Very rugged terrain, difficult to construct 	<ul style="list-style-type: none"> • Less expensive and easier to construct 	
Oasis Valley	OV1	OV3	
	<ul style="list-style-type: none"> • Shortest route and the least expensive to construct 	<ul style="list-style-type: none"> • Resulted from a scoping comment • Requires a more substantial structure over Thirsty Canyon • Has more earthwork 	

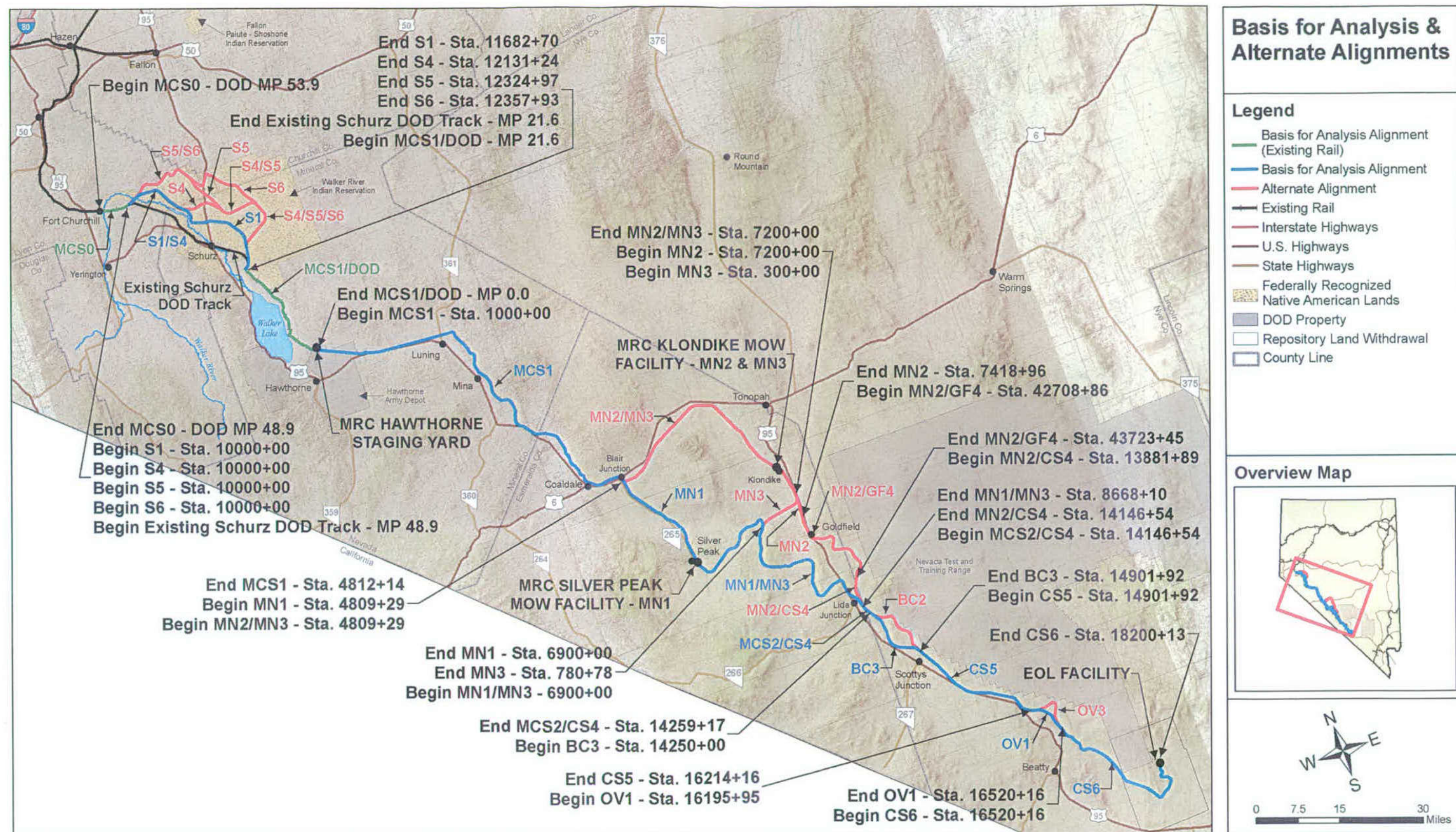


Figure 3-A. MRC Basis for Analysis and Alternate Alignments

4.1 GENERAL FINDINGS

The conceptual design process has developed feasible geometric alignments that support a credible evaluation and impacts assessment. The products of the alignment development process are the *Mina Rail Route Feasibility Study* (BSC 2006), the *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b) for the common segments, this report, and the *Engineered Plan and Profile Drawing Set, Mina Rail Corridor* (NRP 2007e). The plan and profile drawings show:

- Boundary of the Walker River Indian Reservation
- Boundary of the Hawthorne Army Depot
- Plan view of the horizontal alignment, showing:
 - Curve locations
 - Bridge locations
 - Siding locations
 - Match lines between sheets
 - Topographic background
 - Major and some minor public roads
 - Profile of alignment, showing gradients and vertical curve locations
- Curve data table
- Bridge data table

Avoidance of Tunnels – The alternate segments have been engineered to avoid tunnels. Tunnels have high capital costs, and long tunnels have high operational costs.

Adherence to the Bureau of Land Management (BLM) Administrative Land Withdrawal (ALW) for the MRC – The majority of the MRC north of Lida Junction is within the BLM ALW as filed on January 9, 2007. Exceptions to this include:

- A 3-mile portion of S5/S6, where those segments leave the Walker River Indian Reservation, is not protected by the ALW.
- A 3.4-mile portion of MCS1 at Redlich is not protected by the ALW. This was the result of a move in this alignment in response to a scoping comment.
- A 0.5-mile section of the alignment immediately north of the Hawthorne staging yard (including the Union Pacific Railroad [UPRR] interchange tracks) is not protected by the ALW.

South of Lida Junction, the MRC alignment coincides with the CRC. For information on the portions of the CRC shared with the MRC, refer to Section 4.1 of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b). Adherence to the BLM ALW within the CRC is discussed in Appendix F of the same document.

Wide Variation of Engineering Parameters – The alternate alignment segments define a wide variation of engineering parameters in terms of length, earthwork, curvature, and transit time. Tables 4-1 and 4-2 provide a summary of the engineering parameters for the total alignment and the earthwork associated with the alignment used for the basis for analysis. Earthwork is not balanced because locations of cut and fill are not proximate to each other and the level terrain does not allow for a balanced cut and fill.

4.0 Alignment Development Findings

**Table 4-1. Summary of Engineering Parameters
for the Alignment Used as the MRC Basis for Analysis**

Parameter	Value
Length (miles)	254
Maximum Degree of Curve	6° 00' 00"
Length of Curves (feet)	404,341
Length of Curves (miles)	76.58
Length of Curves (% of segment)	30.0
Maximum Engineered Grade (%)	1.96
Maximum Compensated Grade (%)	2.00
Vertical Tangent Length $\geq 1.50\%$ (feet)	273,961
Vertical Tangent Length $\geq 1.50\%$ (miles)	51.89
Vertical Tangent $\geq 1.50\%$ (% of segment)	20.0
Highest Point of Vertical Intersection (PVI) Elevation (feet)	6,476
Lowest PVI Elevation (feet)	3,229
Rise (feet)	4,799
Fall (feet)	5,098
Cut (cubic yards)	17,476,000
Fill (cubic yards)	25,754,000

**Table 4-2. Summary of Earthwork
for the Alignment Used as the MRC Basis for Analysis**

Segment	Length (miles)	Cut (cubic yards)	Fill (cubic yards)
MCS0	5.0	0	56,000
S1	31.9	1,632,000	2,013,000
MCS1/DOD	21.6	0	56,000
MCS1	72.2	915,000	6,738,000
MN1	39.6	2,957,000	7,886,000
MN1/MN3	33.5	3,324,000	2,063,000
MCS2/CS4	2.1	0	134,000
BC3	12.4	306,000	921,000
CS5	24.9	586,000	1,320,000
OV1	6.1	66,000	715,000
CS6	31.8	7,690,000	3,852,000
Totals	281	17,476,000	25,754,000

Construction Right-of-Way (ROW) – The current conceptual design cross sections indicate that the area disturbed by construction activities could range in width between 400 and 800 feet (see *Route Sections and Structures, Caliente Rail Corridor* [NRP 2007h]), sheets 2 through 5 and sheet 22). BLM has articulated a preference for a construction ROW that generally has a uniform width from end to end. No

4.0 Alignment Development Findings

final decisions have been made between DOE, BLM, or Walker River Paiute Tribe regarding the amount of ROW or the configuration of the ROW boundaries. The current conceptual design indicates that a nominal 1,000-foot ROW on BLM property from end to end would reasonably allow for the construction and long-term operation of the NRL along the majority of the alignment. In specific areas, localized conditions such as grading and drainage; placement of operational facilities, wells, or construction camps; or the excavation and transportation of ballast may require additional ROW acreage. In areas with ROW conflicts, wetlands, the Walker River Indian Reservation, private property or other sensitive resources and land issues, specified changes to the ROW will be made accordingly. This is the ROW approach currently guiding NRL development pending refinement during further analysis.

ROW requirements for the Hawthorne staging yard (including the UPRR interchange tracks), maintenance-of-way, and end-of-line facilities will vary according to the terrain and function of the sites. ROW needs for the facilities are presented in the *Facilities-Design Analysis Report, Mina Rail Corridor* (NRP 2007f). For new access roads that are outside of the nominal ROW, a width of 50 feet would be needed for construction and operation. Locations of these roads, along with the ROW needs for construction camps, quarries, and wells, are presented in the *Construction Plan, Mina Rail Corridor* (NRP 2007d).

Operations ROW – ROW requirements for operation of the NRL will be determined by DOE with input from BLM and the Walker River Paiute Tribe.

4.2 SEGMENT-SPECIFIC DATA

Public Roads Crossings and Protection – The alignment segments cross existing public roadways at a number of locations along the MRC. Of these public crossings, eight are paved roadway and the remaining two cross dirt or gravel-surfaced roadways. These locations are summarized in Appendix C, Table C-1, which also presents information about the roadways and the proposed devices for traffic safety protection.

The alignment segments also cross private roads and trails as well as legislated corridors for off-road recreational vehicles. These crossings will not be specifically tabulated, and crossing designs will not be developed until subsequent phases of development.

Drainage Structures – Appendix C lists the structures and includes the estimated station, type of structure (bridge or culvert), number of spans, and total length. The drainage structures are summarized in Table C-2. Because of the smaller drainage areas and the different weather patterns in the western part of the state as compared to those in the eastern part of the state where the CRC is located, there is a significant decrease in the number of major structures proposed.

Alignment Segment Engineering Parameters – The alignment development process resulted in the following engineering parameters for each segment:

- Length
- Geometric features
- Earthwork

These parameters are defined in Appendix D. Values for each of these parameters are, for the most part, specific and measurable terms that can be used to compare one segment to another. Values for these parameters are tabulated in Appendix D following the definition of engineering parameter terms. Values are shown for the Schurz segments, Mina common segments, and MN segments, in geographic order, beginning with the Schurz bypass at the north end of the MRC. Refer to *Alignment Development Report*,

4.0 Alignment Development Findings

Caliente Rail Corridor (NRP 2007b) for the alignment segments from Lida Junction (MSC2/CS4) south to the Repository and end-of-line facility.

Alignment Narrative Reports – Appendix E contains alignment narrative reports for all of the MRC-specific segments. The purpose of these reports is to provide a better understanding of some of the engineering issues encountered in the conceptual design process. The scope of these reports is limited to engineering issues; the reports are not intended to provide a comprehensive picture of each and every factor considered in the day-to-day design activities for the various segments.

5.0 References and Applicable Documents

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- _____. 2007g. *Operations and Maintenance Report, Mina Rail Corridor*. Las Vegas, NV: NRP. NRP-R-SYSW-OM-0003-00, Rev. 00, 30 April 2007.
- _____. 2007h. *Route Sections and Structures Report, Caliente Rail Corridor*. Las Vegas, NV: NRP. NRP-R-SYSW-TY-0001-03, Rev. 03, 15 May 2007.

Appendix A – NRL Conceptual Design Technical Briefs

Refer to Appendix A of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b).

Appendix B – Proposed NRL Design Criteria Basic Elements

Refer to Appendix B of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b).

**Appendix C –
Engineering Findings**

Table C-1. Summary of MRC Road Crossing Data

Station	Road Name	Road Number	Owner	Surface	ADT (vehicles/day)	Traffic Safety Device	Provides Access To
BASIS FOR ANALYSIS							
10940+00	US 95	US 95	State	Paved	2,550	Separation	State Highway Highway over railroad
2200+00	SR 361	SR 361	State	Paved	120	Separation	State Highway Highway over railroad
4800+00	US 6/95	US 6/95	State	Paved	2,200	Separation	State Highway Highway over railroad
5880+00	Silver Peak Road		Esmeralda County	Paved		Active	Silver Peak
8355+00	US 95	US 95	State	Paved	2,050	Separation	State Highway Highway over railroad
15785+00	Unnamed	none	Nye County	Paved		Active	Nevada Test and Training Range – Tolicha Peak
16400+00	Unnamed	none	Nye County	Dirt/Gravel		Passive	Colson Pond
ALTERNATE ALIGNMENT SEGMENTS							
S4							
10850+00	US 95	US 95	State	Paved	2,550	Separation	State Highway Highway over railroad
S5							
10990+00	US 95	US 95	State	Paved	2,550	Separation	State Highway Highway over railroad
S6							
10940+00	US 95	US 95	State	Paved	2,550	Separation	State Highway Railroad over highway
MN2							
7420+00	Silver Peak Road	none	Esmeralda County	Dirt/Gravel	60	Passive	Silver Peak
MN3							
420+00	Silver Peak Road	none	Esmeralda County	Dirt/Gravel	60	Passive	Silver Peak
MN2/GF4							
42970+00	US 95	US 95	Federal	Paved	2,000	Separation	Federal Highway Railroad over highway
OV3							
46190+00	Unnamed	none	Nye County	Dirt/Gravel		Passive	Colson Pond

Notes: 1) All road crossing locations are approximate.
 2) Designers will determine ultimate crossing locations (and other appropriate modifications) on a case-by-case basis.

Table C-2. Structures Proposed for the MRC Basis for Analysis Alignment

Segment	Station	Number of Spans	Length (feet)	Estimated Total Length (feet)	Type
S1	10100+00	26	40	1,040	Precast concrete and deck plate girder
MN1/MN3	8355+00	2	150	300	Multiple box culvert
BC3	14333+86	7	33	231	Precast concrete
	14390+02	16	25	400	Precast concrete
	14404+35	16	25	400	Precast concrete
	14413+04	20	25	500	Precast concrete
	14525+83	5	30	150	Precast concrete
	14775+95	1	104	104	Box culvert
	14782+79	5	45	225	Precast concrete
	14798+00	13	40	520	Precast concrete
	14847+59	6	58	348	Multiple box culvert
	14870+23	2	106	212	Multiple box culvert
	14873+44	1	102	102	Box culvert
	14878+52	1	102	102	Box culvert
CS5	14909+82	1	76	76	Box culvert
	14921+39	1	74	74	Box culvert
	14931+20	1	70	70	Box culvert
	14934+36	1	74	74	Box culvert
	14945+21	1	84	84	Box culvert
	14952+10	1	74	74	Box culvert
	14966+76	2	62	124	Multiple box culvert
	14970+61	2	62	124	Multiple box culvert
	14973+56	2	62	124	Multiple box culvert
	14995+84	2	78	156	Multiple box culvert
	15009+45	2	80	160	Multiple box culvert
	15027+64	1	58	58	Box culvert
	15031+68	1	64	64	Box culvert
	15036+35	1	60	60	Box culvert
	15047+79	1	76	76	Box culvert
	15053+98	1	80	80	Box culvert
	15063+56	1	86	86	Box culvert
	15077+91	3	45	135	Precast concrete
	15088+52	2	82	164	Multiple box culvert
	15101+49	1	70	70	Box culvert
	15113+48	1	70	70	Box culvert
	15132+30	2	76	152	Multiple box culvert

Table C-2. Structures Proposed for the MRC Basis for Analysis Alignment

Segment	Station	Number of Spans	Length (feet)	Estimated Total Length (feet)	Type
	15154+75	5	40	200	Precast concrete
	15218+53	18	33	594	Precast concrete
	15371+70	12	45	540	Precast concrete
	15491+03	9	45	405	Precast concrete
	15540+70	4	25	100	Precast concrete
	15552+34	2	80	160	Multiple box culvert
	15557+02	1	80	80	Box culvert
	15586+45	3	25	75	Precast concrete
	15588+41	3	25	75	Precast concrete
	15592+30	3	25	75	Precast concrete
	15594+89	2	25	50	Precast concrete
	15598+00	2	25	50	Precast concrete
	15642+70	3	25	75	Precast concrete
	15645+65	3	25	75	Precast concrete
	15648+43	4	25	100	Precast concrete
	15661+63	11	30	330	Precast concrete
	15688+62	2	80	160	Multiple box culvert
	15695+68	1	80	80	Box culvert
	15706+33	2	80	160	Multiple box culvert
	15726+73	9	45	405	Precast concrete
	15761+27	2	80	160	Multiple box culvert
	15765+28	2	80	160	Multiple box culvert
	15768+12	2	80	160	Multiple box culvert
	15778+22	1	80	80	Box culvert
	15781+17	1	80	80	Box culvert
	15871+20	3	80	240	Multiple box culvert
	15883+20	3	80	240	Multiple box culvert
	15897+68	9	45	405	Precast concrete
	15909+68	5	100	500	Multiple box culvert
	15928+21	3	100	300	Multiple box culvert
	15952+65	3	110	330	Multiple box culvert
	15962+30	2	100	200	Multiple box culvert
	15987+75	3	90	180	Multiple box culvert
	16046+92	2	100	200	Multiple box culvert
	16121+58	7	45	315	Precast concrete
	15638+54	3	25	75	Precast concrete
	15717+95	10	45	450	Precast concrete

Table C-2. Structures Proposed for the MRC Basis for Analysis Alignment

Segment	Station	Number of Spans	Length (feet)	Estimated Total Length (feet)	Type
	15786+10	8	30	240	Precast concrete
	16032+43	2	100	200	Multiple box culvert
	16104+17	7	45	315	Precast concrete
OV1	16288+06	5	40	200	Precast concrete
	16326+96	9	40	360	Precast concrete
	16337+11	1	140	140	Box culvert
	16344+17	1	144	144	Box culvert
	16349+62	19	40	760	Precast concrete
	16354+51	1	148	148	Box culvert
	16361+69	7	40	280	Precast concrete
	16396+92	2	94	188	Multiple box culvert
	16408+32	3	100	300	Multiple box culvert
	16469+27	5	40	200	Precast concrete
	16481+78	2	106	212	Multiple box culvert
	16519+69	5	106	530	Multiple box culvert
	16568+42	5	40	200	Precast concrete
	16705+62	9	40 and 173	1,028	Precast concrete and deck plate girder
CS6	16885+80	6	40	240	Precast concrete
	16935+65	5	40	200	Precast concrete
	16952+35	5	45	225	Precast concrete
	16998+10	5	40	200	Precast concrete
	17020+45	5	40	200	Precast concrete
	17066+70	5	40	200	Precast concrete
	17139+40	2	84	168	Multiple box culvert
	17140+98	4	24	96	Precast concrete
	17158+96	4	33	132	Precast concrete
	17164+20	4	64	256	Multiple box culvert
	17281+48	5	33	165	Precast concrete
	17319+13	5	45	225	Precast concrete
	17352+30	5	24	120	Precast concrete
	17355+50	5	20	100	Precast concrete
	17380+70	5	24	120	Precast concrete
	17412+33	5	45	225	Precast concrete
	17461+10	5	24	120	Precast concrete
	17464+00	5	24	120	Precast concrete
	17471+20	3	64	192	Multiple box culvert

Table C-2. Structures Proposed for the MRC Basis for Analysis Alignment

Segment	Station	Number of Spans	Length (feet)	Estimated Total Length (feet)	Type
	17529+83	5	45	225	Precast concrete
	17539+20	5	40	200	Precast concrete
	17629+75	5	30	150	Precast concrete
	17800+20	5	40	200	Precast concrete
	17818+80	5	40	200	Precast concrete
	18052+70	5	234	1,170	Multiple box culvert
	18199+13	5	45	225	Precast concrete

Notes: 1) Unless otherwise noted, all structures cross unnamed washes.

2) All bridge length data are approximate.

3) Designers will determine ultimate sizes based on hydraulic and refined alignment data.

4) Bridge locations and quantities may change based on value engineering results and on future review of hydraulic data.

Table C-3. Structures Proposed for the MRC Alternate Segments

Segment	Station	Number of Spans	Length (feet)	Estimated Total Length (feet)	Type
S4	10100+00	26	40	1,040	Precast concrete and deck plate girder
S5	10100+00	26	40	1,040	Precast concrete and deck plate girder
S6	10100+00	26	40	1,040	Precast concrete and deck plate girder
	10940+00	5	40	200	Precast concrete
MN2/GF4	42872+00	4	196	784	Multiple box culvert
	42923+51	5	30 and 80	301	Precast concrete
	42953+50	4	320	1,280	Multiple box culvert
	43087+00	3	80	240	Precast concrete
	43200+51	6	30 and 80	381	Precast concrete
	43273+91	6	31 and 80	381	Precast concrete
	43356+28	7	45	315	Precast concrete
	43397+30	5	28	140	Precast concrete
	43533+37	5	36	180	Precast concrete
	43639+50	10	45	450	Precast concrete
MN2/CS4	14093+70	10	40	400	Precast concrete
BC2	44065+60	7	36	252	Precast concrete
	44117+28	2	86	172	Multiple box culvert
	44148+86	2	74	148	Multiple box culvert
	44176+73	3	66	198	Multiple box culvert
	44184+93	3	70	210	Multiple box culvert
	44202+19	2	120	240	Multiple box culvert
	44229+00	5	40	200	Precast concrete
	44256+72	9	40 and 80	640	Precast concrete
	44410+18	2	244	488	Multiple box culvert
	44424+16	13	40 and 45	575	Precast concrete
	44436+18	3	45	135	Precast concrete

Table C-3. Structures Proposed for the MRC Alternate Segments

Segment	Station	Number of Spans	Length (feet)	Estimated Total Length (feet)	Type
	44444+84	7	45	315	Precast concrete
	44457+40	10	40	400	Precast concrete
	44469+63	3	45	135	Precast concrete
	44488+13	3	45	135	Precast concrete
	44587+55	10	35	350	Precast concrete
	44638+18	2	86	172	Multiple box culvert
OV3	46030+52	5	40	200	Precast concrete
	46055+90	1	120	120	Box culvert
	46057+80	1	120	120	Box culvert
	46118+52	2	172	344	Multiple box culvert
	46169+65	4	168	672	Multiple box culvert
	46181+31	7	30 and 80	461	Precast concrete
	46186+79	1	200	200	Box culvert
	46189+80	1	200	200	Box culvert
	46251+05	5	37	185	Precast concrete
	46306+78	2	192	384	Multiple box culvert
	46313+22	5	30 and 80	301	Precast concrete
	46360+48	2	120	240	Multiple box culvert
	46414+15	5	30	150	Precast concrete
	46427+08	2	124	248	Multiple box culvert

**Appendix D –
Engineering Parameters that Characterize
Alignment Segments**

Table D-1. Definition of Engineering Parameter Terms

Parameter	Definition
Segment Length	
Begin station	Station at beginning of segment. Stationing generally progresses from north to south.
End Station	Station at end of segment
Alignment Length (miles)	Total length of segment, in miles
Horizontal Geometry	
Maximum Degree of Curvature	Sharpest curve within segment
Length of Curves (feet)	Total length of all circular curves within segment (without spiral transition curves)
Length of Curves (miles)	Total length of all circular curves within segment (without spiral transition curves)
Percent of Segment	Percentage of segment length that is within horizontal curves
Vertical Geometry	
Maximum Engineered Grade	Maximum grade (elevation change divided by horizontal length) within segment
Maximum Compensated Grade	Because horizontal curves add rolling resistance to a train (as opposed to tangent track), vertical grades are usually compensated in curves; that is, the grade is reduced by the same amount that the curve adds resistance. Tighter curves add more resistance; thus, the grade is reduced by an appropriate amount. For the NRL, grades were compensated by a factor of 0.04% per degree of curvature.
Tangent Length $\geq 1.50\%$ (miles)	Total length of tangent track that is at a grade of 1.5% or greater
Percent of Segment	Percentage of segment length that is within vertical curves
High PVI Elevation	Highest elevation (approximate) of vertical curve PVI along alignment within segment
Low PVI Elevation	Lowest elevation (approximate) of PVI along alignment within segment
Rise (feet)	Total rise in elevation within segment, measured as stationing increases
Fall (feet)	Total fall in elevation within segment, measured as stationing increases.
Total rise and fall	Sum of total rise and total fall within a segment
Earthwork	
Cut (cubic yards)	Total amount of material excavated from below natural ground line within segment, rounded to the nearest thousand yards
Alluvial	Amount of alluvial material to be excavated, rounded to nearest thousand yards
Rippable	Amount of rippable rock material to be excavated, rounded to nearest thousand yards
Drill and Blast	Amount of rock to be excavated by drilling and blasting, rounded to nearest thousand yards
Fill (cubic yards)	Total amount of material filled above natural ground line within segment, rounded to the nearest thousand yards

Table D-2. Engineering Parameters for the Schurz Segments

Parameter	Segment			
	S1	S4	S5	S6
Beginning Stations	10000+00	10000+00	10000+00	10000+00
Ending Stations	11682+70	12131+24	12324+97	12357+93
Length (miles)	31.9	40.4	44.0	44.7
Maximum Degree of Curve	2° 30' 00"	2° 30' 00"	3° 00' 00"	3° 00' 00"
Length of Curves (feet)	55,354	75,655	74,439	87,513
Length of Curves (miles)	10.48	14.33	14.10	16.57
Length of Curves (% of segment)	32.85%	35.50%	32.02%	37.11%
Maximum Engineered Grade (%)	1.95%	1.94%	1.94%	1.95%
Maximum Compensated Grade (%)	1.97%	2.00%	2.00%	2.00%
Vertical Tangent Length $\geq 1.50\%$ (feet)	4,200	45,676	58,686	68,350
Vertical Tangent Length $\geq 1.50\%$ (miles)	0.80	8.65	11.11	12.95
Vertical Tangent $\geq 1.50\%$ (% of segment)	2.50%	21.43%	25.24%	28.99%
Highest PVI Elevation (feet)	4,367	4,790	5,095	5,095
Lowest PVI Elevation (feet)	4,128	4,134	4,133	4,133
Rise (feet)	213	646	942	1,202
Fall (feet)	486	800	1,096	1,354
Rise and Fall Total (feet)	699	1,446	2,038	2,556
Cut (cubic yards)	1,632,000	4,570,000	8,352,000	6,312,000
Fill (cubic yards)	2,013,000	5,660,000	6,345,000	8,961,000

Table D-3. Engineering Parameters for the MCS1 Segment

Parameter	Segment MCS1
Beginning Stations	1000+00
Ending Stations	4812+14
Length (miles)	72.2
Maximum Degree of Curve	3° 00' 00"
Length of Curves (feet)	107,625
Length of Curves (miles)	20.38
Length of Curves (% of segment)	28.25%
Maximum Engineered Grade (%)	1.96%
Maximum Compensated Grade (%)	2.00%
Vertical Tangent Length $\geq 1.50\%$ (feet)	42,572
Vertical Tangent Length $\geq 1.50\%$ (miles)	8.06
Vertical Tangent $\geq 1.50\%$ (% of segment)	11.17%
Highest PVI Elevation (feet)	5,016
Lowest PVI Elevation (feet)	4,300
Rise (feet)	1,352
Fall (feet)	723
Rise and Fall Total (feet)	2,075
Cut (cubic yards)	915,000
Fill (cubic yards)	6,738,000

Table D-4. Engineering Parameters for the MN Segments

Parameter	Segment		
	MN1	MN2	MN3
Beginning Stations	4809+29	4809+29	4809+29
Ending Stations	8668+10	14146+54	8668+10
Length (miles)	73.1	73.6	87.9
Maximum Degree of Curve	3° 00'00"	2° 00'00"	2° 00'00"
Length of Curves (feet)	152,353	87,147	129,084
Length of Curves (miles)	28.85	16.51	24.45
Length of Curves (% of segment)	39.58%	22.41%	27.82%
Maximum Engineered Grade (%)	1.96%	1.95%	1.96%
Maximum Compensated Grade (%)	2.00%	1.98%	2.00%
Vertical Tangent Length \geq 1.50% (feet)	187,179	73,345	98,887
Vertical Tangent Length \geq 1.50% (miles)	35.45	13.89	18.73
Vertical Tangent \geq 1.50% (% of segment)	48.63%	18.86%	21.31%
Highest PVI Elevation (feet)	6,476	5,893	6,476
Lowest PVI Elevation (feet)	4,272	4,695	4,695
Rise (feet)	2,430	1,580	2,167
Fall (feet)	2,581	1,733	2,318
Rise and Fall Total (feet)	5,010	3,312	4,485
Cut (cubic yards)	6,281,000	2,482,000	4,201,000
Fill (cubic yards)	9,949,000	5,323,000	4,456,000

Note: Refer to Appendix E of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b) for the engineering parameters for the remaining segments common to the MRC and CRC (MN2/GF4, MN2/CS4, MCS2/CS4, BC2, BC3, CS5, OV1, OV3, and CS6).

**Appendix E –
Alignment Narrative Reports**

S1 SEGMENT

Basis for Analysis

Length: 31.9 miles

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in connects to the existing DOD (former Southern Pacific Railroad) tracks at both ends of the proposed trackage.

Major Engineering Issues: In future design efforts, there is a potential need for barriers to guard against blowing sand along southern parts of the alignment.

Major Structures: A new bridge was added across the Walker River and floodplain, which is approximately 1,000 feet long and 40 feet high. A grade separation is located at the US 95 crossing where the highway traverses above the railroad.

Cut/Fill Quantities and Balancing: Overall this segment has higher fill quantities, but the cut/fill quantities are generally balanced. This segment has lower (by 50 percent or more) combined earthwork quantities than any of the other Schurz alignments. The potential exists for better balancing (if desirable) during future design stages.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The first mile of this segment is within the BLM ALW corridor; the remainder is located on tribal lands.

Other Boundary and/or Environmental Constraints: Except for the first mile, the alignment is located entirely within the Walker River Indian Reservation, but the alignment does not impact individual allotments.

Known Utility Issues: No apparent overhead utility issues have been identified for this alignment. The impact from potential underground utilities is currently unknown.

Drainage Issues: No apparent drainage issues for this alignment have been identified.

S4 SEGMENT

Alternate Alignment

Length: 40.4 miles

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in connects to the existing DOD (former Southern Pacific Railroad) tracks at both ends of the proposed trackage.

Major Engineering Issues: This segment is 8 miles longer than the shortest feasible Schurz alignment and has additional summit crossing(s). In future design efforts, there is a potential need for barriers to guard against blowing sand along southern parts of the alignment.

Major Structures: A new bridge was added across the Walker River and floodplain, which is approximately 1,000 feet long and 40 feet high. A grade separation is located at the US 95 crossing where the highway traverses above the railroad.

Cut/Fill Quantities and Balancing: Overall this segment has higher fill quantities, but the cut/fill quantities are generally balanced. This segment has higher combined earthwork quantities than the S1 segment but less than the S5 or S6 segments.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The first mile of this segment is within the BLM ALW corridor; the remainder is located on tribal lands.

Other Boundary and/or Environmental Constraints: Except for the first mile, the alignment is located entirely within the Walker River Indian Reservation, but the alignment does not impact individual allotments.

Known Utility Issues: No apparent overhead utility issues have been identified for this alignment. The impact from potential underground utilities is currently unknown.

Drainage Issues: No apparent drainage issues for this alignment have been identified.

S5 SEGMENT**Alternate Alignment****Length: 44.0 miles**

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in connects to the existing DOD (former Southern Pacific Railroad) tracks at both ends of the proposed trackage.

Major Engineering Issues: This segment is 12 miles longer than the shortest feasible Schurz alignment and has additional summit crossing(s). In future design efforts, there is a potential need for barriers to guard against blowing sand along southern parts of the alignment.

Major Structures: A new bridge was added across the Walker River and floodplain, which is approximately 1,000 feet long and 40 feet high. A grade separation is located at the US 95 crossing where the highway traverses above the railroad.

Cut/Fill Quantities and Balancing: Overall this segment has higher cut quantities, but the cut/fill quantities are generally balanced. This segment has higher combined earthwork quantities than the S1 or S4 segments.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The first mile of this segment is within the BLM ALW corridor. There is no defined corridor for the additional 3-mile segment that leaves tribal lands. The remainder of the alignment is located on tribal lands.

Other Boundary and/or Environmental Constraints: Except for the first mile and an additional 3-mile segment, the alignment is located entirely within the Walker River Indian Reservation; however, the alignment does not impact individual allotments.

Known Utility Issues: No apparent overhead utility issues have been identified for this alignment. The impact from potential underground utilities is currently unknown.

Drainage Issues: No apparent drainage issues for this alignment have been identified.

S6 SEGMENT

Alternate Alignment

Length: 44.7 miles

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in connects to the existing DOD (former Southern Pacific Railroad) tracks at both ends of the proposed trackage.

Major Engineering Issues: This segment is 13 miles longer than the shortest feasible Schurz alignment and has additional summit crossing(s). In future design efforts, there is a potential need for barriers to guard against blowing sand along southern parts of the alignment.

Major Structures: A new bridge was added across the Walker River and floodplain, which is approximately 1,040 feet long and 40 feet high. A grade separation is located at the US 95 crossing where the railroad traverses above the highway.

Cut/Fill Quantities and Balancing: Overall this segment has higher fill quantities, but the cut/fill quantities are generally balanced. This segment has higher combined earthwork quantities than the S1 or S4 segments.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The first mile of this segment is within the BLM ALW corridor. There is no defined corridor for the additional 3-mile segment that leaves tribal lands. The remainder of the alignment is located on tribal lands.

Other Boundary and/or Environmental Constraints: Except for the first mile and an additional 3-mile segment, the alignment is located entirely within the Walker River Indian Reservation; however, the alignment does not impact individual allotments.

Known Utility Issues: No apparent overhead utility issues have been identified for this alignment. The impact from potential underground utilities is currently unknown.

Drainage Issues: A major drainage is located along US 95 at the highway crossing, which will require a longer railroad bridge or a large box culvert under the railroad embankment.

MCS1 SEGMENT

Basis for Analysis

Length: 72.2 miles

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in begins at/near the existing DOD (former Southern Pacific Railroad) tracks at the U.S. Army Thorne yard, northeast of Hawthorne, and ends at Blair Junction along US 6/95.

Major Engineering Issues: No major engineering issues have been identified.

Major Structures: Grade separations (highway over railroad) are required at the SR 361 crossing near Luning and the US 6/95 crossing at Blair Junction.

Cut/Fill Quantities and Balancing: Overall this segment has higher fill quantities due to the need to build railroad embankments and the lack of rough terrain requiring excavations.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The alignment is within the ALW with the exception of 0.5 mile approaching the Hawthorne staging yard (including the UPRR interchange tracks) and 3.5 miles where the alignment was moved near Redlich.

Other Boundary and/or Environmental Constraints: The segment is located primarily on BLM lands. The alignment stays to the east side of the valley near Redlich in order to better avoid mining claims.

Known Utility Issues: Two overhead transmission line crossings are located west of Luning. The impact from potential underground utilities is currently unknown.

Drainage Issues: No apparent drainage issues for this alignment have been identified.

MN1 SEGMENT (MN1 + MN1/MN3)

Basis for Analysis

Length: 73.1 miles

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in begins at Blair Junction along US 6/95 and ends near Lida Junction along US 95 after crossing the Montezuma Range.

Major Engineering Issues: The segment traverses between the town of Silver Peak and local industries and crosses a significant mountain range not found on alternate segments.

Major Structures: A grade separation (highway over railroad) is required at the US 95 crossing near Lida Junction.

Cut/Fill Quantities and Balancing: Overall this segment has higher fill quantities (by nearly 50 percent). The fill quantities are nearly double the combined earthwork quantities of the other MN segments.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The segment is located within the ALW.

Other Boundary and/or Environmental Constraints: The segment is located primarily on BLM lands, and an attempt has been made to avoid mining claims.

Known Utility Issues: Several overhead transmission line crossings are located north and south of the town of Silver Peak. The impact from potential underground utilities is currently unknown.

Drainage Issues: The US 95 highway overpass at Jackson Wash will require a longer bridge to span both the railroad and a drainage.

MN2 SEGMENT (MN2/MN3 + MN2 + MN2/GF4 + MN2/CS4)

Alternate Alignment

Length: 73.6 miles

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in begins at Blair Junction along US 6/95 and ends near Lida Junction along US 95 after running almost parallel to these highways.

Major Engineering Issues: No major engineering issues have been identified.

Major Structures: A grade separation (highway over railroad) is required at the US 95 crossing just south of the town of Goldfield.

Cut/Fill Quantities and Balancing: Overall this segment has higher fill quantities due to the need to build railroad embankments and the lack of rough terrain requiring excavations. This segment requires less combined earthwork quantities than the other MN segments.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The segment is located within the ALW.

Other Boundary and/or Environmental Constraints: The segment traverses historic mining areas near the towns of Millers and Goldfield.

Known Utility Issues: Two overhead transmission line crossings are located east of Blair Junction (at the towns of McLeans and Millers). Power lines, water tanks and other utilities are located at and in the vicinity of Goldfield. The impact from potential underground utilities is currently unknown.

Drainage Issues: No apparent drainage issues for this alignment have been identified.

MN3 SEGMENT (MN2/MN3 + MN3 + MN1/MN3)

Alternate Alignment

Length: 87.9 miles

The procedures, issues, and problems related to the design of this segment are as follows:

Tie-in Points: The tie-in begins at Blair Junction along US 6/95 and ends near Lida Junction along US 95.

Major Engineering Issues: This segment crosses a significant mountain range, which is not found on alternate segments.

Major Structures: A grade separation (highway over railroad) is required at the US 95 crossing near Lida Junction.

Cut/Fill Quantities and Balancing: Overall this segment has higher fill quantities due to the need to build railroad embankments and the lack of rough terrain requiring excavations.

Position Within the 1.0-mile BLM ALW Corridor (if applicable): The MN2 North and MN1 South segments are located within the ALW. There is no defined corridor for the 9.0-mile MN3 segment.

Other Boundary and/or Environmental Constraints: The segment traverses historic mining areas near the town of Millers.

Known Utility Issues: Two overhead transmission line crossings are located east of Blair Junction (at the towns of McLeans and Millers). The impact from potential underground utilities is currently unknown.

Drainage Issues: The US 95 highway overpass at Jackson Wash will require a longer bridge to span both the railroad and a drainage.

Note: Refer to Appendix F of *Alignment Development Report, Caliente Rail Corridor* (NRP 2007b) for alignment narrative reports for the remaining segments common to the MRC and CRC alignments (MN2/GF4, MN2/CS4, MCS2/CS4, BC2, BC3, CS5, OV1, OV3, and CS6).